Fall 2009
University of Michigan-Department of Mathematics
http://www.math.lsa.umich.edu/seminars/index.shtml
Ann Arbor, MI 48109-1043
September 28th – October 4th

Monday, September 28

2:10-3:00pm **Topics in Algebraic Geometry** --- Jesse Kass (UM) *Vector Bundles on Elliptic Curves* --- 3866 EH
3:10-5:00pm **Group Theory/Lie Theory/Number Theory Seminar** --- Michael Khoury (UM) *Spherical functions for quasi-split unitary groups* --- 4096 EH
4:10-5:00pm **Several Complex Variables and Complex Dynamics Seminar** --- Elizabeth Wulcan (UM) *Stabilization of monomials maps* --- 3096 EH
4:10-5:00pm **Student Combinatorics** --- Brian Mann (UM) *Tropical Curves* --- 3866 EH
4:10-6:00pm **Geometry & Physics** --- Anton Kapustin (Caltech) *Three-dimensional topological field theory and algebraic geometry* --- 4088 EH
5:15-6:30pm **Teaching Mathematics** --- Not meeting this week --- 3096 EH

Tuesday, September 29

2:10-3:00pm "**What is … " Seminar** --- Joel Smoller (UM) *What is … the Mathematics of General Relativity?* --- 3096 EH
3:10-4:00pm **Student Geometry/Topology** --- Jeff Meyer (UM) *Semisimple Lie Groups* --- 4096 EH
3:10-4:00pm **Algebra Seminar** --- TBA --- 3096 EH
4:10-5:00pm **Colloquium** --- Matthew Gursky (U of Notre Dame) *Some recent applications of fully nonlinear equations to geometry* --- 1360 EH

Wednesday, September 30

3:10-4:00pm **Student Arithmetic Seminar** --- Thomas Wright (Johns Hopkins) *Diophantine Questions and the Adeles* --- 3866 EH
3:10-4:00pm **Geometric Function Theory Seminar** --- Peter Duren (UM) *Schwarzian derivatives of convex mappings* --- 4096 EH
4:10-5:00pm **Student AIM Seminar** --- Jeremy West (UM) *A Primer on Stochastic Calculus* --- 3866 EH
4:10-6:00pm **Algebraic Geometry Seminar** --- Not meeting this week --- 3088 EH
4:30-6:00pm **Logic Seminar** --- TBA --- 3096 EH

Thursday, October 1

12:00-1:00pm **Mathematical Biology Seminar** --- Not meeting this week --- 4096 EH
3:10-4:00pm **Commutative Algebra Seminar** --- Karl Schwede (UM) *Rationality of Hilbert-Kunz multiplicity for 2 dimensional graded rings, part 2* --- 3096 EH
3:10-4:00pm **Topology Seminar** --- TBA --- 4096 EH
4:10-5:00pm **Financial/Actuarial Mathematics Seminar** --- Tom Emmerling (UM) *Perpetual Cancellable Call Option* --- 3088 EH
4:10-5:00pm **Differential Equations** --- Barbara Keyfitz (Ohio State) *The sonic line as a free boundary: Stability under perturbations* --- 4088 EH
4:10-5:00pm **Math Club** --- Chelsea Walton (UM) *Noncommutative Algebra ?!* --- 2nd floor Nesbitt Common Room

Friday, October 2

10:30-11:30am **Theoretical Computer Science Seminar** --- Jelani Nelson (MIT) *A Space-Optimal Streaming Algorithm for Sketching Small Moments* --- 3941 CSE
3:10-4:00pm **Applied and Interdisciplinary Mathematics Seminar** --- Adam Oberman (Simon Fraser U) *Robust solvers for the Monge-Ampere equation and other fully nonlinear elliptic equations* --- 1084 EH

Friday, October 2 … continued

3:10-4:00pm **Intersection Theory Study Seminar** --- Hunter Brooks (UM) & Andrew Kiluk (UM) TBA --- 3866 EH

3:10-4:00pm **Geometry Seminar** --- Juan Souto (UM) *The action of the mapping class group on the unit tangent bundle* --- 3096 EH

4:10-5:00pm **Combinatorics** --- Ilia Itenberg (Strasbourg) *Tropical Welschinger invariants* --- 3866 EH

UPCOMING EVENTS

Michigan Conference on Topology and Physics

Feb 6-7, 2010

ABSTRACTS FOR THE WEEK OF SEPT. 28 – OCT. 4, 2009

Topics in Algebraic Geometry
Monday, September 28, 2:10-3:00pm
3866 EH
Jesse Kass (UM)
Vector Bundles on Elliptic Curves

I will discuss Atiyah's paper.

Group Theory/Lie Theory/Number Theory Seminar
Monday, September 28, 3:10-5:00pm
4096 EH
Michael Khoury (UM)
Spherical functions for quasi-split unitary groups

Given a group G with maximal compact subgroup K, we say that a complex-valued function is "spherical" if it is an eigenfunction for the natural action of the Hecke algebra H(G,K). Various classes of spherical functions, including Whittaker functions and the more general Whittaker-Shintani functions, have been much studied in the literature of number theory and representation theory. In the first part of this talk, I will comment on the relevance of such objects for the Langlands program. In the second part, I will mention some recent results on spherical functions for quasi-split unitary groups, as well as some techniques which seem to be useful more generally.

Several Complex Variables and Complex Dynamics Seminar
Monday, September 28, 4:10-5:00pm
3096 EH
Elizabeth Wulcan (UM)
Stabilization of monomials maps

The construction of many dynamical objects associated with rational maps (such as invariant currents) requires the induced maps on cohomology to be compatible with iteration. I will discuss the problem of finding a model where (f^n)^*=(f^*^n) when f is a monomial map. This is joint work in progress with Mattias Jonsson.

Student Combinatorics
Monday, September 28, 4:10-5:00pm
3866 EH
Brian Mann (UM)
Tropical Curves

A tropical curve is, loosely, a balanced graph in the real plane which can be gotten as some sort of degeneration of the image of a complex algebraic curve under some map. I will briefly discuss the motivation for studying tropical curves (how they arise from algebraic objects, and how properties of tropical curves relate to properties of algebraic curves), and then concentrate solely on the combinatorial properties of such objects. Namely, I will talk about the problem of enumerative geometry, and a combinatorial criterion to tell when a tropical curve is irreducible.

Geometry & Physics Seminar
Monday, September 28, 4:10-6:00pm
4088 EH
Anton Kapustin (Caltech)
Three-dimensional topological field theory and algebraic geometry

It is well-known that to any real symplectic manifold one can associate a 2d topological field theory which computes the Gromov-Witten invariants. Similarly, to any complex symplectic manifold one can associate a 3d topological field theory: the Rozansky-Witten model. The complex analogue of the Fukaya-Floer category turns out to be a certain 2-category whose objects are, roughly speaking, sheaves of categories over complex Lagrangian submanifolds. I will explain the relationship of this 2-category to a categorification of the deformation quantization and to a categorified version of the Chern character.

Student Geometry/Topology
Tuesday, September 29, 3:10-4:00pm
4096 EH
Jeff Meyer (UM)
Semisimple Lie Groups

This talk will be a survey on results related to semisimple Lie groups. In particular, I will discuss some ways in which these groups arise when one tries to solve geometric problems such as those related to superrigidity, strong rigidity, and the isospectral problem. We will see how the rich structure of semisimple Lie groups allows one to use tools from other areas of mathematics (such as measure theory and algebraic number theory) to answer these geometric questions.

Colloquium
Tuesday, September 29, 4:10-5:00pm
1360 EH
Matthew Gursky (U of Notre Dame)
Some recent applications of fully nonlinear equations to geometry

Nonlinear PDEs frequently appear in differential geometry, for example when studying the cutrvature of hypersurfaces in Euclidean space. Indeed, many of the fundamental advances in the theory of partial differential equations in the last century were inspired by considering very concrete problems in geometry. Over the last ten years there has been considerable interest in certain fully nonlinear equations in conformal geometry. These equations arise when considering ”uniformization” problems in higher dimensions. After describing some classical precedents, I will explain the origin of these new equations and describe some interesting applications.

Student Arithmetic Seminar
Wednesday, September 30, 3:00-4:00pm
3866 EH
Thomas Wright (Johns Hopkins)
Diophantine Questions and the Adeles

In this talk, we discuss new developments in adelic methods for Diophantine problems. In particular, we show how they can be used to approximate the number of solutions to Diophantine equations, as well as how they might be used to shed light on questions such as the Goldbach Conjecture or Twin Prime Conjecture.

Geometric Function Theory Seminar
Wednesday, September 30, 3:10-4:00pm
4096 EH
Peter Duren (UM)
Schwarzian derivatives of convex mappings

For a function f analytic and locally univalent in the unit disk D, the Schwarzian norm is ||Sf|| = sup(1-|z|^2)^2|Sf(z)|, where Sf =(f''/f')'-(1/2)(f''/f')^2 is the Schwarzian derivative and the supremum is taken over all points z in D. In 1949, Nehari proved that ||Sf||\leq 2 implies that f is (globally) univalent in D. The bound is sharp but the converse is false. It is natural to ask what other geometric information may be encoded in the Schwarzian norm. In 1976, Nehari proved with some difficulty that every convex mapping satisfies ||Sf||\leq 2. We give a simple proof based only on the Schwarz lemma. We show further that bounded convex mappings have ||Sf||< 2, a result that Nehari claimed, but his proof seems to be flawed. We also discuss some connections with quasidisks. (Joint work with Martin Chuaqui and Brad Osgood.)

Commutative Algebra Seminar
Thursday, October 1, 3:10-4:00pm
3096 EH
Karl Schwede (UM)
Rationality of Hilbert-Kunz multiplicity for 2 dimensional graded rings, part 2

I'll talk about work of Brenner on this topic.

Financial/Actuarial Mathematics Seminar
Thursday, October 1, 4:10-5:00pm
3088 EH
Tom Emmerling (UM)
Perpetual Cancellable Call Option

In this talk, I'll examine the valuation of a generalized American-style option known as a Game-style call option in an infinite time horizon setting. The specifications of this contract allow the writer to terminate the call option at any point in time for a fixed penalty amount paid directly to the holder. Valuation of a perpetual Game-style put option was addressed by Kyprianou (2004) in a Black-Scholes setting on a non-dividend paying asset. Here, we undertake a similar analysis for the perpetual call option in the presence of dividends and find qualitatively different explicit representations for the value function depending on the relationship between the interest rate and dividend yield.

Differential Equations
Thursday, October 1, 4:10-5:00pm
4088 EH
Barbara Keyfitz (Ohio State)
The sonic line as a free boundary: Stability under perturbations

The study of self-similar solutions of multidimensional conservation laws leads to systems of equations that change type. Change of type occurs either across a transonic shock or at a sonic line. Often the sonic line appears as a free boundary in the formulation of the problem. Some recent numerical (and experimental) discoveries of a new kind of shock reflection ('Guderley Mach reflection') lead to interesting and still unresolved questions concerning the nature of the self-similar solutions in this generic case. In this talk, I will present some analysis of a simple model for this phenomenon, using the transonic small disturbance equation. The simplified problem seems amenable to analysis, but we are just beginning to make progress. This is a report on current joint work with Allen Tesdall and Kevin Payne.

Math Club
Thursday, October 1, 4:10-5:00pm
2nd floor Nesbitt Common Room
Chelsea Walton (UM)
Noncommutative Algebra ?!

We prove the following statement.
Theorem 1. *Noncommutative algebra is a beautiful subject!*
Proof. The result follows from the lemmas below.
Lemma 2. *Noncommutative algebra aids I n the study of objects arising in nature. In other words the subject goes hand in hand with physics, e.g. with the Uncertainty Principle.*
Lemma 3. *We are already familiar with examples of noncommutative structures. Moreover there exist others that are readily accessible, e.g. the Weyl algebra.*
Lemma 4. *The field has been in existence for quite some time and remains of strong interest to mathematicians. (Representation theory!)*
We refer to the talk for proofs of these lemmas.

Theoretical Computer Science Seminar
Friday, October 2, 10:30-11:30am
3941 CSE
Jelani Nelson (MIT)
A Space-Optimal Streaming Algorithm for Sketching Small Moments

A Space-Optimal Streaming Algorithm for Sketching Small Moments Jelani Nelson MIT We settle the 1-pass space complexity of (1+eps)-approximating the pth moment, for real p with $0 < p <= 2$, of a vector receiving updates to its coordinates in a data stream. Our upper bound (for $p < 2$) improves upon previous algorithms of [Indyk, JACM '06] and [Li, SODA '08]. This improvement comes from showing an improved derandomization of Indyk's algorithm by using k-wise independence for small k, as opposed to using the heavy hammer of a generic pseudorandom generator against space-bounded computation such as Nisan's PRG. Our lower bound improves upon previous work of [Alon-Matias-Szegedy, JCSS '99] and [Woodruff, SODA '04], and is based on showing a direct sum property for the 1-way communication of the gap-Hamming problem. This is joint work with Daniel M. Kane (Harvard University) and David P. Woodruff (IBM Almaden Research Center)

Applied and Interdisciplinary Mathematics Seminar
Friday, October 2, 3:10-4:00pm
1084 EH
Adam Oberman (Simon Fraser U)
Robust solvers for the Monge-Ampere equation and other fully nonlinear elliptic equations

The Monge-Ampere equation is a classical fully nonlinear elliptic equation. While its origins go back hundreds of years, there has been renewed interest in this equation because of the applications to image warping and optimal transportation.

These applications require robust (convergent) solvers for the equation. However building solvers has been notoriously difficult, with a number of recent contributions by several groups of authors yielding unsatisfactory results.

In this talk, we will begin by giving some background on the equation, and on the different attempts which have been made using ideas from Classical Convex Analysis, Finite Elements, and finally, finite difference methods.

In a first paper, we build convergent finite difference schemes for the equation.

After the renewed interest in the equation, we developed some new solvers, with two goals:

1. building the simplest possible solver to see when it would break down (justifying the use of the convergent solver)
2. building a model of the other methods to see when those break down (showing that the other methods can fail)

In the second part of the talk, we will describe some other fully nonlinear equations and a general class of methods for solving them. These equations include:

- the obstacle problem,
- the infinity Laplacian,
- the equation for motion of level sets by mean curvature,
- the Pucci maximal and minimial equations,
- an equation for the convex envelope.

Geometry Seminar
Friday, October 2, 4:10-5:00pm
3096 EH
Juan Souto (UM)
The action of the mapping class group on the unit tangent bundle

I will prove that the standard action of the mapping class group of a surface Σ on the unit tangent bundle $T^1\Sigma$ is conjugated to a Lipschtiz action but not homotopic to any smooth action.

Combinatorics
Friday, October 2, 4:10-5:00pm
3866 EH
Ilia Itenberg (Strasbourg)
Tropical Welschinger invariants

Welschinger invariants are designed to bound from below the number of real rational curves which pass through a given real generic collection of points on a real rational surface. In some cases (for example, in the case of the projective plane) these invariants can be calculated using G. Mikhalkin's approach which deals with a corresponding count of tropical curves (piecewise-linear objects which can be seen as algebraic curves over the tropical semifield).

We define a series of tropical Welschinger-type invariants of the projective plane. These invariants can be seen as real tropical analogs of relative Gromov-Witten invariants, and are subject to a recursive formula. As application we obtain several results concerning Welschinger invariants.

This is joint work with V. Kharlamov and E. Shustin.